Nursing students' learning dynamics with clinical information and communication technology

Abstract

Background

The learning of nursing students can be facilitated through direct and/or indirect experiences of using clinical information and communication technology during clinical placements. However, nursing students experience difficulties in using technology for learning. Despite the difficulties, nursing students' learning dynamics with technology in real clinical contexts is poorly understood.

Objectives

To develop a theoretical model by identifying nursing students' learning dynamics with clinical information and communication technology and the factors influencing the dynamics.

Design

A constructivist grounded theory approach was employed in order to develop the theoretical model.

Settings

This research was conducted by recruiting nursing students from four universities in Seoul, South Korea.

Participants

Sixteen fourth year nursing students were recruited by purposive sampling.

Methods

This research collected qualitative interview data in up to four rounds of interviews using open-ended and semi-structured interview questions. A total of 23 interviews were conducted. The data were transcribed verbatim. All interview data were analysed using three coding methods; initial, focused, and theoretical coding. NVivo 11 was used for data management.

Results:

This research developed a theoretical model of nursing students' learning dynamics with clinical information and communication technology. The model explains three dynamics that influence nursing students' use of clinical information and communication technology (interpersonal, organisational and emotional dynamics) and the students' responses regarding the dynamics for learning in clinical contexts.

Conclusions:

Nursing educators can use the theoretical model to understand how best to support nursing students in navigating their clinical environments to build competency in using clinical information and communication technology.

Background

Technological innovation in recent decades has resulted in the rapid development of clinical information and communications technology (ICT) in the health sector (McMullen et al., 2014). For nurses, ICT can support clinical decision-making, diagnosis, and implementation of nursing interventions (Fujino & Kawamoto, 2013; Rouleau et al., 2017), thus enhancing the safety of nursing care delivery (Fagerström, Tuvesson, Axelsson, & Nilsson, 2017). The electronic medical record (EMR) is one such example of clinical ICT that supports nursing tasks, as it allows management of a large amount of patient information and patient monitoring (McMullen et al., 2014). For these reasons, nursing students are positive about the benefit of using ICT in nursing practice (Lee & Clarke, 2015).

In education as well, ICT is widely adopted by nursing students for their learning, as it allows easy acquisition of nursing information and supports the construction of clinical knowledge (Johnson & Bushey, 2011). A national survey in the United States of America reported that 82.9% of nursing students believed that using technology will improve their learning (NLN & Wolters-KluwerHealth, 2016). González, Manzanares, and Peinado (2017) also reported that nursing students who use ICT for learning have higher satisfaction and academic achievement than those who do not use ICT.

ICT has been actively integrated into clinical settings in South Korea (hereafter Korea), making it one of the leading countries in the development and implementation of clinical ICT (Hong, Byun, & Kim, 2016). By 2014, the penetration rate of electronic medical record (EMR) systems in clinical settings was 96% in hospitals and 89.2% in clinics among 554 hospitals and 906 clinics in Korea (Park & Han, 2017). For this reason, nursing students in Korea are constantly in contact with clinical ICT during their clinical placements. It is an essential aspect of nursing care, and so nursing students should build sufficient competency in using clinical ICT prior to completion of their degree (Fetter, 2009). By doing so during clinical placements, experiential learning will enhance the relevance of the clinical ICT skills learnt (Webb, Clough, O'Reilly, Wilmott, & Witham, 2017).

Nevertheless, it has been reported that nursing students suffer several constraints in their learning with clinical ICT, including a lack of proficiency in obtaining clinical information through ICT (Ota, Inagaki, Fujiwara, & Azuma, 2017), and a shortage of institutional support (Shin, Cummings, & Ford, 2018). Although the students are struggling with using ICT for their learning in clinical environments, there is a dearth of research exploring how nursing students use clinical ICT to learn (i.e., learning dynamics with clinical ICT) and what factors influence their learning with clinical ICT during clinical placements.

Therefore, the aim of this research was to explore Korean nursing students' experiences of learning with clinical ICT, and develop a theoretical model based on their experiences.

Design

This research adopted constructivist grounded theory (CGT). CGT focuses on co-constructing meanings between researchers and participants through active interactions, and identifying contextual influences on the meanings for constructing theory (Charmaz, 2014). Thus, CGT was adopted in this research as 1) the research aimed to develop a theoretical model regarding nursing students' learning dynamics with clinical ICT, 2) clinical contexts should be considered to understand the dynamics and 3) the researchers' epistemological perspectives support constructivism.

Participants

Sixteen nursing students were recruited by purposive sampling from four universities in Seoul, Korea. Students were eligible for inclusion if they were nursing students enrolled in a nursing bachelor's degree course, had had learning experience in clinical environments for three months or more and spoke Korean. Nursing students who had had any clinical learning experience outside Korea were excluded in order to prevent any influence of clinical cultures from other countries. After initial purposive sampling, participant recruitment continued using theoretical sampling until theoretical saturation was reached (Charmaz, 2014). The mean age of the students was 21.9 years and fourteen students were female.

Data Collection

This research collected qualitative interview data by four rounds of intensive interviews using open-ended and semi-structured interview questions (there were six, ten, four and three interviews during the first, second, third and fourth round interviews respectively - a total of 23 interviews) (Charmaz, 2014). The four rounds do not represent multiple data collection points as in a longitudinal study, but represent the CGT process of data analysis influencing future data collection. Consequently, the issues addressed in each interview round reflected issues that had arisen in the preceding round of interviews.

All the interviews were conducted by the first author, ensuring consistency (an aspect of rigour) in data collection and interpretation. We initially prepared an interview guide that consisted of three parts: 1) initial open-ended questions, 2) intermediate questions and 3) ending questions (Charmaz, 2014). For example, the author asked the initial open-ended

questions with a non-judgmental and non-leading approach such as "*Tell me about your experience of clinical placements*". After these, the author asked intermediate questions such as '*What is your experience with clinical ICT?*' to narrow the scope of interview topics by focusing on the research topics (i.e., intensive interviews) (Charmaz, 2014). Questions such as "*Is there anything else we need to know to understand your experience with clinical ICT better?*" were also asked as ending questions. The interview guide was modified in the course of the interviews, according to emerging new topics.

One week before the interviews, the participants were informed briefly about the topics of interview questions via email to give them time to reflect on their experience in relation to the interview topic and to encourage more reflective and analytical answers. The interviews were voice-recorded using a digital recorder after informed consent had been obtained. Each interview lasted approximately one and a half hours, and the interviews were conducted in a secure and calm room in a university or a hospital. Furthermore, reflective memos made by the first author during the interview period were collected as qualitative data.

Data Analysis

The interview scripts were transcribed verbatim. All interview data were analysed using three coding methods: initial, focused, and theoretical coding, guided by CGT (Charmaz, 2014). Throughout the initial coding, core characteristics of the interview data were captured as a taxonomy of codes. Based on the initial codes, core categories were developed using focused coding. As a final step, the relationships of core categories were identified for theory construction through theoretical coding (Charmaz, 2014). During the coding process, constant comparison was also undertaken between data, codes and categories (Charmaz, 2014). NVivo 11 was used for data management during the analyses. The second and third authors critically reviewed the analysis process and interpretation.

Qualitative researchers are required to deal carefully with the language used in their research, attending to the underlying meanings of language (van Nes, Abma, Jonsson, & Deeg, 2010). Therefore, this research carefully designed a translation plan for the interview quotations used in this study from Korean to English to preserve the meanings in the transcripts. A group of five bilingual Koreans contributed to the translation. In particular, one participant was a bilingual nursing student (Student-9) and also contributed to the translation group, which is consistent with CGT that emphasises the co-constructing of meaning with participants.

Reflexivity

The reflexivity of researchers plays an important role in CGT, as it is a co-constructive process (Charmaz, 2014). The first author, who conducted all interviews and mainly interpreted the data, earned a bachelor's degree in nursing and worked as a registered nurse for five years in a hospital in Seoul, Korea. In addition, the first author had engaged in undergraduate nursing education, including clinical placement education for seven years in Korea. Therefore, the first author has a deep understanding of nursing educational and clinical contexts in Korea. All authors have experience in qualitative data analysis with an epistemological viewpoint of constructivism. These experiences were reflected in the data analysis in this research.

Rigor

To assure quality, this research adopted the four criteria of rigor suggested by Charmaz (2014) (i.e., credibility, originality, resonance, and usefulness). For credibility, a systematic CGT process including a constant comparison and translation process was conducted by considering social and clinical contexts. The originality of findings was investigated through comparison with the literature. As CGT encourages co-construction of meanings between researchers and participants, the interpretation of each interview was shared with each participant to seek their confirmation for both resonance and credibility. Moreover, this research achieved theoretical saturation by sufficiently explaining nursing students' learning dynamics with ICT in clinical contexts for resonance. Lastly, we believe that the developed theoretical model has implications about supporting students in using clinical ICT (i.e., it has usefulness).

Ethical considerations

This research obtained the University of Edinburgh Research Ethics Committee's ethical approval and written informed consent was obtained from the participants.

RESULTS

1) Nursing students' perception of ICT

Having grown up within a technologically advanced society, nursing students in this research believe that they are sufficiently competent with ICT use.

> *As people from our generation have used ICT since we were little, I think we would be able to use ICT in whatever situation we are thrown into. [confidently] Even if it is a*

new ICT device, we can adapt to it easily because I think in our generation, we can figure things out by ourselves. If I buy a new, cutting-edge smartphone, I can figure out all of its functions and how to use it after playing with it a few times. (Student-16)

As they are familiar with ICT, nursing students actively adopt ICT as a crucial tool for their learning.

All nursing students including myself use computers and smartphones for our learning… [stressing] I can't imagine studying without these devices. (Student-8)

This is because they understand the benefits of ICT for their learning, particularly for information gathering to build knowledge.

Well, I can easily find the information that I want by using the internet and I can study more effectively. (Student-13)

2) Learning with ICT in clinical contexts

Nursing students have noted the rapid transformation of clinical ICTs in Korea through clinical placement experiences. Just as they have found benefit in using ICT for their learning, the students believe the advancement of clinical ICT has brought advantages for nursing care and hence have a positive attitude towards clinical ICT.

Due to the development of ICT, I think the quality of nursing care for patients has definitely improved… That is why all the good hospitals in Korea have the most advanced ICT installed. (Student-8)

Nursing students in this study mostly use computers, on which they utilise EMR for their learning in clinical environments.

EMR is the most often used ICT (in clinical environments). As for me, other than the EMR, there is no other ICT that I use. Actually, I can't use any other ICT except for the EMR. (Student-3)

Their main purpose for using EMR during clinical placements is to access the large amount of clinical information it contains to build their nursing knowledge.

We can get more patient information and their lab results, and look up medication information by using EMR. So, it is very useful for our nursing education. (Student-1)

I can find a lot of useful information by EMR, [stressing] if I use the EMR properly! If I just click one button, I can get all the information on a specific drug. There are so many benefits from using the EMR... As the information that I can't get from the patients is already stored and organised in the EMR, I can save time in obtaining information (that I want), and it is useful for my knowledge building. (Student-4)

As above, the student attaches the condition of '*if I can use EMR properly*'. This condition is associated with three dynamics that influence their use of EMR during clinical placements: interpersonal, organisational, and emotional dynamics.

- **Interpersonal dynamics**

Nursing students are expected to adhere to nurses' strict discipline in Korean clinical environments. The relationship between nurses and nursing students is therefore hierarchical, which influences students to become more passive. This passivity hinders their use of ICT for learning.

> *Because of the regulations towards nursing students, [disappointedly] I can't use ICT much in hospitals. I can use the EMR but other than that, ICT does not have a big impact on me. I want to use EMR (for my learning), but I can't, because I am a student (of lower hierarchy). I may be able to use the computers in hospital but even then, I can't use it freely*. (Student-2)

Permission from nurses needs to be obtained before the students can use clinical ICTs, including EMR, or even their personal ICT devices (e.g., smartphone). Nurses are therefore the most influential people on nursing students' ICT usage in clinical contexts.

> *It is obviously the nurses! None of students would deny this… Nurses influence my usage of ICT. For example, we have to get permission from the nurses to use ICT. When I want to use it, I have to ask.* (Student-15)

Additionally, the students experience difficulties in obtaining permission because nurses are too busy in Korean clinical environments.

> *Nurses are usually too busy. They don't have enough time to take care of us… We have to find opportunities to ask for permission, but it is difficult*. (Student-12)

- **Organisational factor**

Despite competency in ICT use in their daily lives, clinical ICT is new to the nursing students. However, education on how to use clinical ICT effectively is insufficient in hospitals and universities. Hence, they are unable to use clinical ICT effectively.

> *I have never received clinical ICT education. So, I can't use ICT because I don't know how to use it.* (Student-3)

Even when nursing students are allowed to use clinical ICT, there are insufficient ICT devices, such as computers for nursing students in clinical environments.

I can't use the ICT freely due to the limited number of devices. For example, if there are six nurses, they will need six computers, but there are only [stressing] five computers, then there isn't any that we can even use. (Student-10)

Another issue affecting nursing students' ICT usage is the difference in ICT environments between hospitals. Because of this, the students must adjust to new ICT environments constantly as they move to other hospitals for clinical placements.

Programmes are different from hospital to hospital. There is no standardised programme and it is different between hospitals. Because of that difference, I always have to ask the nurses and learn how to use a new programme every time I start a new clinical placement. (Student-3)

Issues of confidentiality also influence nursing students' clinical ICT usage. As students deal with patient information via EMR, the students believe that there is a concern about confidentiality regarding the students' ICT usage in hospitals.

That's why as a student, I am not able to use the internet, and only the EMR (when using the computer) due to the confidentiality issue. Some hospitals even make us sign a patient confidentiality agreement... As I have mentioned, there are many restrictions regarding ICT use (for nursing students) due to this risk of breaching patient confidentiality. (Student-6)

- **Emotional dynamics**

The complexity of both interpersonal and organisational dynamics influences nursing students' emotions regarding ICT use during clinical placements.

These influences are mostly negative. There are several points for us to consider regarding ICT use during clinical placement. [sighing] It really does stress us out. (Student-16)

[dejectedly] Using ICT in clinical environments can be very difficult on me psychologically… Although I have to use the ICT for my clinical placements, I should consider many things before use. So, I feel pressured… [sighing] (Student-7)

Moreover, nursing students have emotional burdens when using clinical ICT, as they believe their usage can produce generally negative outcomes, further increasing passivity in clinical ICT usage.

(Due to my incompetency,) I am worried that I would either accidently damage the ICT, or if I do not save it properly I could accidentally delete (the medical records). I think my (ICT) competency is 80%. I have the competency but because I am worried, I am too afraid to touch it. (Student-2)

Even just now with the EMR, the reason why I couldn't just try clicking on any button is that I'm afraid of clicking the wrong thing by mistake and deleting the medical record. [worriedly] That becomes medical malpractice. I am really afraid of causing that... (Student-3)

3) Nursing students' negotiation with the clinical dynamics

Due to the influence of the three influential dynamics, nursing students have negative experiences of ICT usage in clinical environments. However, they attempt to understand and conform to the situation due to their role as a student.

I haven't been able to use ICT much during clinical placements, but I understand that (hospital ICT) devices are not frequently given to students (to handle). (Student-15)

Nevertheless, nursing students need to use ICT to complete assignments and understand nursing duties in clinical contexts. Hence, they actively analyse the conditions in clinical contexts for opportunities to use ICT, even though the context is not favourable.

I have to analyse the atmosphere of the ward … to look for an opportunity to use ICT… [dejectedly] That makes me feel uncomfortable. It is still not easy to analyse the atmosphere… although I am now in the final year (of nursing course) (Student-4)

Moreover, nursing students have to learn how to use clinical ICT themselves due to the lack of ICT education. However, this does not result in effective use of clinical ICT for their learning.

We explore how to use ICT by ourselves. Because we use it without knowing anything about it, we end up not learning anything… [disgruntledly] No one properly teaches me how to use the ICT, but I should learn the ICT myself to learn something. I know it is not effective at all. I think nurses would also know. (Student-8)

4) A theoretical model of Learning Dynamics with Clinical ICT

Based on the findings, a theoretical model named 'Learning Dynamics with Clinical ICT' was developed (Figure 1). This model explains how nursing students use clinical ICT to learn in clinical contexts. The square refers to the contextual dynamics, with students at the circular centre. The rings radiating from the centre indicate nursing students' internal processes in interacting with the contextual dynamics in clinical environments. This model reflects a constructivist's learning paradigm that focuses individual learning process (learner-centre process) and contextual influences on learning (Cooper, 1993; Vygotsky, 1978).

Figure 1. A theoretical model of Learning Dynamics with Clinical ICT

DISCUSSION

ICT supports nursing students' learning, as it offers more opportunities to connect with information. However, this research found that students had difficulties in learning with clinical ICT due to the three dynamics in clinical environments.

Organisational dynamics

This research found that the clinical environments are not prepared to facilitate nursing students' use of ICT. Nursing students struggled to find available ICT devices, especially computers, which they use the most for EMR. This reduced availability of computers for nursing students' use was also reported by Willmer (2007). Another factor that restricts nursing students' use of EMR is the concern about security. Baillie, Chadwick, Mann, and Brooke-Read (2013) similarly reported that nursing students experienced hesitation from the nurses regarding their EMR access due to patient confidentiality. Hospitals in which nursing clinical placements take place also cited security of patient information as their biggest concern regarding nursing students' access to their ICT systems (Fetter, 2009). Moreover, as most hospitals in Korea use different EMR systems from each other (Cho, Kim, Kim, Kim, & Kim, 2010), this research identified that nursing students had difficulties adjusting to new EMR systems when they rotated placement sites every one to two weeks. Thus, they were unable to use the EMR effectively for their learning at each hospital.

This research also indicated that the participating nursing students struggled with using ICT, because neither universities nor hospitals offer sufficient EMR training. As nursing students are expected to develop competencies in using clinical ICT to qualify as nurses (Schleyer, Burch, & Schoessler, 2011), they should receive sufficient and appropriate education in both university and clinical environments during their nursing program to build their informatics competencies (Fetter, 2009). However, there is uncertainty about the transferability of skills learnt in universities to real clinical settings, as there is a limit to the clinical ICT devices in universities (Ip, Jones, & Jacobs, 2007). Thus, clinical ICT education in real clinical environments is essential to ensure relevance in clinical practice, and is in keeping with Dewey's recommendation of direct experience in genuine contexts (Dewey, 1916).

Interpersonal dynamics in nursing students' use of ICT

Nursing students in this research reported that the nurses influence their ICT use the most, as they are the main supervisors of the students' clinical education and the students have to receive their permission to use ICT in Korean clinical environments. It was also highlighted that nursing students' access to ICT was affected by nurses' attitudes (Ward & Moule, 2007). Students would ask nurses to log them into EMR as a way of seeking permission as they do not have EMR login details (Willmer, 2007). However, seeking permission for ICT access could be arduous for the students. A study that explored nursing students' clinical education in Korea reported that students are expected to be very disciplined and courteous within the strict nursing hierarchy in clinical environments (Lee, Clarke, & Carson, 2018). Therefore, nursing students, who are in a lower social position, experience difficulties in freely asking and receiving permission from the nurses, who are in higher positions. Furthermore, the students were not allowed to use their personal ICT devices (i.e., smartphones) during clinical placements. However, the devices can offer rapid, immediate, efficient and accurate access to the information needed by nursing students during clinical placements (Johansson, Petersson, & Nilsson, 2013; Phillippi & Wyatt, 2011). Moreover, as they are able to search for the information that they have interest in by using their personal ICT devices during clinical placements, they would be able to be self-directed in their learning (Phillippi & Wyatt, 2011).

Emotional influences on nursing students' use of ICT

Many studies, such as Lee et al. (2018) and Shaban, Khater, and Akhu-Zaheya (2012), have reported on nursing students' emotional burdens during clinical placements. However, few nursing research studies have linked the emotional burdens to their ICT use in clinical environments, although there are some studies that dealt with nurses' emotional burdens, such as their fear of using ICT (Toofany, 2006). The nursing students in this research disclosed their emotional burdens in clinical ICT use. They needed to continuously consider many factors, including their hierarchical position and having to analyse the clinical contexts to find appropriate opportunities to use the EMR. This process causes them emotional distress, particularly the fear of making mistakes leading to medical errors or harm to patients. This emotional distress may be connected with insufficient clinical ICT education from both hospitals and universities, with the nursing students reporting that they do not know how to use ICT in the clinical environments properly, resulting in a lack of confidence and increased anxiety. George and Davidson (2005) asserted that the lack of preparedness in

general and basic ICT use can cause anxiety when attempting to use new ICT. Thus, again, sufficient clinical ICT education for nursing students is recommended to reduce the students' emotional burdens.

Nursing students' negotiation with the clinical dynamics

This research identified nursing students' responses to the dynamics discussed above.

The nursing students attempt to understand and conform to the limitations experienced in using ICT during clinical placements. This attitude of conformity to given social conditions is related to the cultural characteristics of Confucianism in Korea in which motivation to achieve harmony is strong (Triandis, 1995). The risk of being rejected by the society that they are currently involved in is likely to be diminished by their conforming (Levett-Jones & Lathlean, 2009). The nursing students would also expect to receive permission and opportunities to use clinical ICT through their efforts to conform.

Nursing students also analyse clinical contexts by employing intuitive reasoning when they attempt to use ICT during clinical placements. However, they would be in danger of misinterpreting the clinical contexts or the nurses' intentions. This can cause more difficulties in using ICT, as misinterpretation of clinical contexts causes decreased ICT confidence, which is compounded by insufficient ICT education. Nilsen (2009) argues that a learner's confidence is a key factor for motivation in the learning process. Moreover, when using ICT, high levels of confidence were found to enhance learning outcomes and facilitate learners' self-directed learning (Gravill, Compeau, & Marcolin, 2002).

Without sufficient education in clinical ICT and encouragement to use ICT during clinical placements, it would be unreasonable to expect nursing students to be masters in using clinical ICT as soon as they become nurses. Although inefficient, the nursing students attempted to learn and use ICT on their own, particularly the EMR, during clinical placements. It can be called self-directed learning, but it should be noted that it is difficult to learn how to use clinical ICT without formal education in its use. Alexander Pope, an English writer, wrote that: "*A little learning is a dangerous thing*" (Pope, 1711, p. 14). Applied to this case, it raises awareness that we should be concerned about nursing students' unsupported self-directed learning in using clinical ICT, as it may cause more serious medical errors than not giving them opportunities and sufficient education to use ICT.

Limitations and future research

Direct application of the findings of this research is limited to other countries with similar cultural contexts to Korea. Therefore, replication of this study in other geographical areas is

recommended to understand nursing students' navigation through different cultural contexts to learn about clinical ICT. Moreover, this research only focused on nursing students' perspectives. As nurses are reported to be the most influential on students' use of clinical ICT, exploration of nurses' perspectives on students' clinical ICT use would be useful to enhance understanding of the interpersonal dynamics between nurses and nursing students and the impact on students' learning with clinical ICT.

Recommendations

To combat the difficulties nursing students in this research faced with unfamiliar clinical ICT, we recommend that introductory courses on patient confidentiality and how to use key clinical ICT (e.g. EMR) be provided at universities prior to placements. When starting clinical placements, time should be committed to orienting nursing students to the clinical ICT used onsite. Such changes can also be made on a higher level and regulated by the local nursing regulatory body to ensure consistency in nursing education delivered at different sites. This will boost students' competencies and confidence in using clinical ICT, and nurses and hospitals will be more willing to let them use clinical ICT.

Conclusion

While it would be unrealistic to expect full competency in using every clinical ICT device or software program upon qualifying, nursing students need to feel confident in approaching the use of clinical ICT in preparation for their future roles. Nursing educators can use the theoretical model in this research to understand how best to support nursing students navigating the clinical dynamics to build competency in clinical ICT. By basing their strategies on student-centred education, similar to the theoretical model in this research, nursing educators should aim to minimise or remove the barriers to using ICT in clinical environments. We acknowledge the logistical and financial implications that would come with our recommendations; therefore, we propose for the changes to take place in slow, measured steps, and to begin with recognising the issues and engaging in dialogue.

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